

# Health Consultation

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## Final Report on Exposure Investigation Findings

**VALLEY VIEW CONCENTRATED ANIMAL FEEDING OPERATIONS**  
(Aliases: **CONCENTRATED ANIMAL FEEDING OPERATIONS**  
and **CONFINED ANIMAL FEEDING OPERATIONS**)

**GREEN CASTLE, SULLIVAN COUNTY, MISSOURI**

**AUGUST 8, 2003**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES**  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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## HEALTH CONSULTATION

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and CONFINED ANIMAL FEEDING OPERATIONS)

GREEN CASTLE, SULLIVAN COUNTY, MISSOURI

Prepared by

Missouri Department of Health and Senior Services  
Section for Environmental Public Health  
Under a Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

## **Statement of Issues and Background**

### **Statement of Issues**

The Missouri Department of Health and Senior Services (DHSS) and the Agency for Toxic Substances and Disease Registry (ATSDR) conducted an Exposure Investigation (EI) to assess the community's level of exposure to airborne ammonia from a swine Concentrated Animal Feeding Operation (CAFO) in northern Missouri. This Health Consultation serves as a follow-up to the draft Health Consultation dated September 30, 2002, which was released for public comment. This Health Consultation not only reports and interprets DHSS' data and findings of this EI, but will also address public comments made on the initial draft document.

### **Background**

Concentrated Animal Feeding Operations (CAFOs) have existed in Missouri since the mid 1990's. Thirteen Class 1A (greater than 7,000 units) swine CAFOs have been permitted in northern Missouri since 1995. Premium Standard Farms (PSF) owns 10 of these facilities located in Mercer, Putnam and Sullivan counties. PSF owns and houses several thousand head of swine at each of its facilities (1, 2). One thousand hogs are housed in each barn, and eight barns are grouped together in a pod. Process waste is collected from the pods and stored in lagoons. It is later land applied as fertilizer on fields owned by the company and on fields leased from surrounding landowners (3). Land application of process waste is accomplished via various surface and subsurface application methods; traveling irrigation guns are used to spray wastewater on hay fields, irrigation sprayers are used to irrigate wastewater on crop fields and subsurface injection is used to knife the process waste directly into the ground.

Citizens living near these CAFOs have expressed concern that their quality of life has been adversely impacted and that they have experienced an increase in health problems since the CAFOs began operation. The health conditions or problems most frequently mentioned include breathing problems such as increased asthma attacks and attacks with greater severity, recurrent sinus problems, headaches, burning/watering eyes, and a rash on the inside of the mouth and throat that resembles thrush. In addition, citizens claim their quality of life has decreased due to not being able to spend time outdoors or open their windows (due to the odors) (1). In the fall of 1999 and fall of 2000, the U.S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR) conducted downwind perimeter air monitoring for ammonia, hydrogen sulfide, and other amines at the White Tail facility in Putnam County. Elevated levels of ammonia were detected. The levels of hydrogen sulfide were considered background levels (1). Based on this EPA data, DHSS determined the chemical of concern for the EI to be ammonia.

The purpose of this Exposure Investigation (EI) is to assess the community's level of exposure to airborne contaminants from a swine CAFO. The major objectives of the EI include:

- Survey community households for potential sources of ammonia exposure, and to collect demographic information;
- Collect air monitoring data within or near individual households for ammonia;
- Collaborate with MDNR and EPA on their collection of ambient air monitoring data for ammonia and hydrogen sulfide; and,
- Assure community awareness concerning the EI process (1).

The EI protocol and participant consent form are included as Appendix 1 of this document.

A census of the homes within a two-mile radius of the boundaries of PSF's Whitetail and Valley View facilities was conducted by personnel from DHSS's Section for Environmental Public Health (SEPH) in the spring of 2000. The census was used to determine how many homes are present and how many individuals live within this radius. Information collected during the census included: name of respondent, address, telephone number, number of individuals living at the address and their name and age, length of time at this address, if they are employed by PSF and age of their home. Based on the census, it was decided that the EI would be limited to the community around the Valley View facility. This facility had a greater concentration of residents closer to the facility boundary than the Whitetail facility.

The Valley View CAFO site is a 4,597-acre grow/finish swine facility permitted to house 49,459 animal units, which equates to 123,648 hogs (2). The site is owned by PSF. It is located on Missouri Highway 129 approximately 5 miles south of Green City, Sullivan County, Missouri. The site boundary is less than one mile from the town of Green Castle, Sullivan County, Missouri. Green Castle is four miles east of Green City on Missouri Highway 6 (see Figure 1) (4). The Valley View facility has been permitted for operation since June 6, 1997 (5).

All residences within one mile of the Valley View facility, along with randomly chosen homes within a one-two mile radius, were invited to answer an exposure survey questionnaire. SEPH staff visited homes to obtain a signed consent form for participation in the EI in May 2001. When a consent form was signed, a questionnaire was administered to one person 18 years of age or older residing in the home and who is not employed by PSF. The questionnaire asked questions about frequency of odors, time of day and days of the week when odors are noticed, types of sewage and water systems used, heating and air conditioning use, time spent outdoors, gardening practices, and types of cleaning products used. If a participant had a private water source, (i.e., well, cistern or pond/lake) for their water supply, a water sample would have been collected and analyzed for ammonia, total sulfides, nitrates and nitrites, and total coliform. Everyone who consented to participate was on a public water supply. This was due to the poor groundwater quality in the area. Specifically, the shallow aquifer has a low yield, while the

deeper aquifer has elevated Total Dissolved Solids and is quite saline. DHSS obtained a signed consent to participate and a completed exposure questionnaire from 77 homes within a one-mile radius of the boundary of the Valley View facility and 39 homes within the 1-2 mile radius.

The nearest downwind residences were the focus of the EI. Homes to be monitored were selected based on the homeowner's willingness to participate; the proximity of the home to the CAFO site perimeter; and whether the home was in the downwind direction of the CAFO as determined by weather models used by MDNR. Six homes were chosen for locating the air monitoring equipment. From September 20 to October 3, 2001, air sampling occurred simultaneously at one indoor and one outdoor location of each home. Sampler inlets were placed at breathing zone height. Ammonia was monitored at each residence for at least three days (approximately 72 hours). To account for any changes in other potential exposure sources, residents of these six homes were asked to complete the questionnaire a second time to assist in determining severity and frequency of odors as well as possible indoor ammonia sources.

DHSS used four Innova 1312 Photoacoustic Multi-Gas Monitors to monitor for ammonia. The instrument detection limit for ammonia is approximately 0.070 parts per million (ppm); values below 0.070 ppm may not be exact measurements (6). Each instrument was calibrated/certified by California Analytical Instruments, Inc. (CAI), at the site prior to the first residential installation. Certified calibration used a 10 parts per million (ppm) ammonia standard. After calibration, the instrument was challenged with ammonia concentrations of 0.5, 1.0, and 5 ppm to verify a linear response in the concentration range of interest. Because these instruments also determine methane and carbon dioxide levels simultaneously with ammonia levels, CAI also calibrated the instruments for methane and carbon dioxide using certified 20 ppm and 1000 ppm standards, respectively.

A DHSS representative was on-site during the 12-day monitoring period. DHSS acquired access/monitoring consent, kept records concerning the location of the monitoring equipment, and addressed any concerns expressed by the community participant during monitoring.

Monitoring was conducted concurrently with the EPA and MDNR ambient air sampling outside the residence. MDNR also continued ambient air sampling at their stationary monitor located in a side yard of a residence located at the southern edge of Green Castle, in the prevailing wind direction. This station provides hourly average ammonia levels, as well as wind speed and direction and temperature readings, 24-hours a day. This monitor has been in operation since September 13, 2001.

The EPA and MDNR each collected meteorological data with meteorological stations set up with their field monitoring equipment. EPA also conducted 12-hour time-weighted air sampling for ammonia in the homes participating in the EI using tube samplers, which were co-located with the DHSS sampling equipment.

All data with personal identifying information were kept in a locked cabinet. Individual addresses were assigned a unique number. All forms, surveys, participant folders, etc., were identified by this number.

The EI was designed to conduct the air sampling during a time when it was anticipated that the lagoons would be drawn down and the process waste applied on fields. It was anticipated that this would be the period of maximum potential residential exposure. However, during the 12 days of the EI, process waste application occurred on or around the Valley View facility on only 5 days. (7)

Table 1 presents the DHSS sampling results for 24-hour sampling periods. On average, winds were in the direction of the monitors 10% of the time of measurements, when measuring from the CAFO. However, the difference in measured ammonia levels between time periods when wind was in the direction of the monitors and periods when wind was not in the direction of the monitors was statistically significant (i.e., ammonia levels were significantly higher when the wind was blowing toward the monitors). The mean daily ammonia levels detected inside and outside each house are displayed in Table 1. The EPA tube sampler data is in general agreement with the data presented in Table 1. Data from the stationary monitor at Green Castle has exceeded the chronic and acute inhalation MRL values for brief periods. Through December 2002, the maximum hourly average measured at the DNR stationary monitor was 0.579 ppm ammonia. Mean monthly averages have ranged from 0.0029 ppm to 0.0128 ppm. On August 26, 2002, the hourly average for midnight, 1 a.m. and 2 a.m. exceeded the chronic inhalation MRL of 0.3 ppm and for the first two hours it exceeded the acute inhalation MRL of 0.5 ppm (hourly averages - 0.515 ppm, 0.579 ppm, and 0.401 ppm). (8)

**Table 1: Average Ammonia Concentrations (parts per million) by 24-hour Period, Missouri Department of Health and Senior Services Valley View CAFO Exposure Investigation, September 20, 2001- October 3, 2001**

<b>House Number</b>		<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>
<b>1028</b>				
	INSIDE	0.1865	0.1843	0.1648
	OUTSIDE	0.035*	0.1159	0.0800
<b>1032</b>				
	INSIDE	0.7172	0.8158	0.5439
	OUTSIDE	0.1900	0.035*	0.035*
<b>1039 (first sampling period)</b>				
	INSIDE	0.0440	0.035*	0.035*
	OUTSIDE	0.0451	0.035*	0.035*
<b>1039 (second sampling period)</b>				
	INSIDE	0.0369	0.0480	0.0666
	OUTSIDE	0.035*	0.0784	0.0639
<b>1039 (third sampling period)</b>				
	INSIDE	I.M.**	I.M.**	0.035*
	OUTSIDE	I.M.**	I.M.**	0.035*
<b>1094</b>				
	INSIDE	0.0798	0.0671	0.2516
	OUTSIDE	0.035*	0.0966	0.0368
<b>1110</b>				
	INSIDE	0.6779	0.5085	0.5880
	OUTSIDE	0.0457	0.0814	0.0364
<b>1111</b>				
	INSIDE	0.0468	0.0382	0.035*
	OUTSIDE	0.035*	0.035*	0.035*

\*Values of less than 0.070, the instrument detection limit, were substituted with 0.035 ppm to calculate averages.

\*\*I.M. = Instrument Malfunction, resulting in either partial or no data for the 24-hour period

Hourly averages were also calculated. The highest hourly average recorded for all monitoring was from 11:24 p.m. on September 26, 2001, to 12:22 a.m. on September 27, 2001, for the interior of residence 1032. This hourly average was 2.74 ppm. The corresponding outdoor hourly average for this time period at this residence was 0.58 ppm, which was also the maximum outdoor hourly average. Figures 2-9 display hourly indoor and outdoor data. Table 2 presents

the maximum single inside and outside ammonia levels during each 24-hour period, based on DHSS sampling results. Overall, the highest single reading was 4.3 ppm from the interior of residence 1032. Residents of 1032 report no use of ammonia cleaning products.

**Table 2: Maximum Discrete Ammonia Concentrations (parts per million) by 24-hour Period, Missouri Department of Health and Senior Services Valley View CAFO Exposure Investigation, September 20, 2001- October 3, 2001**

<b>House Number</b>		<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>
<b>1028</b>				
	INSIDE	0.4602	0.3846	0.4220
	OUTSIDE	0.2770	0.4786	0.3286
<b>1032</b>				
	INSIDE	4.3067	2.0393	2.0251
	OUTSIDE	0.8768	0.1467	0.1330
<b>1039 (first sampling period)</b>				
	INSIDE	0.1266	0.1229	0.1624
	OUTSIDE	0.2868	0.0703	0.0597
<b>1039 (second sampling period)</b>				
	INSIDE	0.1935	0.1780	0.1766
	OUTSIDE	0.0861	0.4391	0.8123
<b>1039 (third sampling period)</b>				
	INSIDE	0.1723*	0.1935*	0.1441
	OUTSIDE	I.M.*	I.M.*	0.1651
<b>1094</b>				
	INSIDE	0.1962	0.2077	1.0446
	OUTSIDE	0.1823	0.3262	0.1453
<b>1110</b>				
	INSIDE	1.9213	0.7478	1.3641
	OUTSIDE	0.7305	0.8417	0.1765
<b>1111</b>				
	INSIDE	0.1822	0.1441	0.1780
	OUTSIDE	0.0942	0.0434	0.1274

\*I.M. = Instrument Malfunction, resulting in either partial or no data for the 24-hour period

Analysis of the questionnaire data indicates that respondents feel odors are at their worst in the evening and early morning hours. In general, Figures 2-9 confirms this result. For the most part, respondents also indicated that the odors were not worse on any particular days of the week. Further, most respondents indicate they notice the odors once per day. There was no consistent

response to how often during the week odors are noticed (responses varied from once per day to three or more times per day). In addition, there was no consistent response to how long the odors last (responses varied from less than 15 minutes to 8-10 hours).

As stated previously, this health consultation not only serves to report and interpret DHSS data and findings of this EI, but also serves to address public comments made to the initial draft document dated September 30, 2002. Community members were mailed a fact sheet explaining the results of the EI and provided an explanation on how to submit comments concerning the contents of the draft health consultation. Additionally, DHSS hosted a public availability session on November 12, 2002, to provide community members an opportunity to speak one-on-one with DHSS staff and to discuss the draft document. DHSS responded to all persons commenting on the draft health consultation by sending a letter to each individual that addressed their concerns and/or comments. A summary of comments and responses may be found in Appendix 2 of this document.

## **Discussion**

Potential residential pathways of exposure to ammonia at this site include inhalation of ammonia and ingestion, inhalation and dermal contact with contaminated groundwater. Since no private wells were located around this site, the groundwater pathway does not exist. Therefore, this E.I. only evaluated the residential ammonia inhalation pathway.

To determine if airborne ammonia exposure is occurring at levels that could potentially result in adverse health effects, the 24-hour average ammonia concentrations were compared to ATSDR Minimum Risk Levels (MRLs). An MRL is an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of noncarcinogenic adverse health effects over a specified duration of exposure (9). A contaminant dose greater than the MRL does not necessarily mean adverse health effects are likely; instead, the MRL is used as a screening tool to determine if there needs to be further evaluation of whether this contaminant might cause adverse health effects at this site. Ammonia has an acute (exposure period up to 14 days) inhalation MRL of 0.5 ppm and a chronic inhalation MRL of 0.3 ppm (9). Residences 1032 and 1110 consistently had 24-hour averages above the chronic and acute MRLs. All other monitoring periods at all residences were below the chronic MRL. Because the highest 24-hour average ammonia levels are greater than both the chronic and acute MRLs, we evaluated ammonia inhalation exposure further.

This MRL was derived from a human study which examined a group of workers at a soda ash factory. In this study, the workers were exposed for about 14 years to airborne ammonia at a level of 12.5 ppm. This exposure had no effect on pulmonary function or odor sensitivity in the soda ash workers compared to a control group from the same factory that was not exposed to ammonia (9). Since airborne concentrations recorded during this EI are significantly lower than

those reported in this study, health effects are not likely, even at the intermittent peak periods of ammonia exposure. Based on this, we would not expect significant non-cancer adverse health effects due to exposure to ammonia indoors in residences 1032 and 1110 which were measured during this EI. However, it is important to remember that land application of effluent only occurred for less than half the period of this EI; thus, the maximum period of exposure is not believed to have been attained during this EI. Neither ATSDR nor EPA has classified ammonia as to its carcinogenic (cancer-causing) potential from inhalation exposure (9).

In general, the data does not show a clear or consistent relationship between indoor ammonia levels and outdoor levels. There were only four 24-hour monitoring periods when the outside average was greater than the inside average (all were below the chronic MRL). In reviewing the residences with the highest indoor levels (1032 and 1110), there is only one time period (in residence 1032) where the indoor level may potentially be affected by the outdoor level. At all other times, there are no indications of indoor levels rising as a result of increasing outdoor levels. Thus, these sources of ammonia must be other than ambient outdoor levels, or indoor levels are accumulating while ambient conditions allow outdoor levels to diffuse. Possibilities for other sources are soil gas migration or sources from within the homes such as smoking, pets; used diapers; cleaning products, window cleaner or floor wax containing ammonia; and smelling salts. Residents of 1032 report no use of ammonia cleaning products, however 1110 did report use of ammonia products. Although monitors were downwind during only 10% of the monitoring period, ammonia concentrations were significantly higher when wind was directed from the site to the monitor.

### **Child Health Initiative and Susceptible Subpopulations**

Since ammonia is a respiratory tract irritant, persons who are hyper-reactive to other respiratory irritants, or who are asthmatic (especially asthmatic children), would be expected to be more susceptible to ammonia inhalation effects. Ammonia inhalation can exacerbate existing symptoms including cough, wheeze, nasal complaints, eye irritation, throat discomfort, and skin irritation. These symptoms should become milder once the exposure stops (9).

### **Conclusions**

Air monitoring conducted during this EI did not find airborne ammonia exposures occurring at a level expected to cause adverse health effects. Furthermore, it does not appear that residential indoor ammonia levels are being significantly increased by outdoor concentrations. Thus, airborne ammonia exposures during the period of the EI are classified as a no apparent public health hazard.

However, the EI occurred during a period that may not necessarily represent the period of maximum exposure. Actual exposures could be greater during times when process waste is being land-applied on a continuing basis. For such a period, sufficient data is not available to

determine what level of exposure may be occurring. For example, data from the stationary monitor at Green Castle has exceeded the chronic and acute inhalation MRL values for brief periods. Accordingly, this site is classified as an indeterminate public health hazard for airborne ammonia exposures during these periods.

Finally, even though monitors were downwind during only 10% of the monitoring period, ammonia concentrations were significantly higher when wind was directed from the site to the monitor. This suggests that the site is affecting ambient ammonia concentrations.

No generalization of the data can be made from this EI to any other site or any date/time different from when it was collected. Weather conditions vary, at a minimum, from month to month and sometimes from hour to hour. Topographic conditions are different from site to site. The information is specific to this site at the specific date and time it was collected.

## **Recommendations**

1. Monitoring should continue at MDNR's stationary site in Green Castle. DHSS will monitor data received from MDNR's stationary monitor in Green Castle for any patterns or seasonal increases in ammonia concentrations.
2. MDNR has relocated the stationary monitor at a home involved in the EI that is closer to the Valley View facility. This monitor should remain at the home for at least 12 months. If data from the MDNR stationary monitor demonstrates that exposures may be occurring at levels higher than those measured in this EI (especially during periods of ongoing effluent land application), consider conducting additional residential indoor and outdoor monitoring.
3. Consult with occupants of residences 1032 and 1110 to better understand what other sources of ammonia may be contributing to the indoor air ammonia levels found.

## **Public Health Action Plan**

The Public Health Action Plan (PHAP) for the Valley View CAFO site contains a description of actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR), and other involved parties. The purpose of the PHAP is to ensure that this health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to contamination from the site. Included is a commitment from DHSS, ATSDR, or both to follow-up on this plan to ensure that it is implemented.

1. DHSS/ATSDR will monitor data from the stationary Green Castle monitor to determine if ammonia levels may be rising to levels of health concern.
2. DHSS will contact occupants of residences 1032 and 1110 to assist in identifying indoor sources of ammonia that were not identified during the EI.
3. DHSS/ATSDR will consider conducting further monitoring to capture airborne ammonia data during periods of ongoing effluent land application.

**Report prepared by:**

Scott Clardy, Missouri Department of Health and Senior Services  
Lori Harris-Franklin, Missouri Department of Health and Senior Services

**Attachments:**

Figure 1      Site Map

Figures 2 - 9 – Indoor and Outdoor Hourly Averages of Residences involved in Exposure Investigation

Appendix 1: Valley View Confined Animal Feeding Operation Exposure Investigation Protocol

Appendix 2: Summary of Public Comments and Responses Health Consultation

## References

1. Missouri Department of Health and Senior Services and Agency for Toxic Substances and Disease Registry. Joint exposure investigation environmental monitoring protocol, Valley View CAFOs Facility, Green Castle, Sullivan County, Missouri. Missouri Department of Health and Senior Services; 2001 Sept.
2. Missouri Department of Natural Resources. Missouri State Operating Permit No. MO-0118478 issued to Premium Standard Farms for PSF Valley View Finishing Site, 1997 June 6.
3. Missouri Department of Health and Senior Services. Briefing paper on concentrated animal feeding operations: focus on swine. Missouri Department of Health and Senior Services.
4. Premium Standard Farms. Site Maps, Missouri Site Locations and Summary. Premium Standard Farms; 1998 Sept.
5. Missouri Department of Natural Resources. Telephone conversation between Ogle Hopkins and Lori Harris-Franklin, Missouri Department of Health and Senior Services. 2002 Aug 23.
6. California Analytical Instruments, Inc. Letter to Scott Clardy, Missouri Department of Health and Senior Services from Bill Taylor concerning comparisons between a Teco Model 17 and Innova Model 1312. Orange, California. 2001 May 7.
7. Premium Standard Farms. Work Orders No. 7389, 7452 and 7453 for land application of effluent. 2001 Sept. and Oct.
8. Missouri Department of Natural Resources. Air Quality System, Raw Data Report 1-Hour Listing AMP350H. 2002 August.
9. Agency for Toxic Substances and Disease Registry. Toxicological profile for ammonia. Atlanta: US Department of Health and Human Services; 1990 Dec.

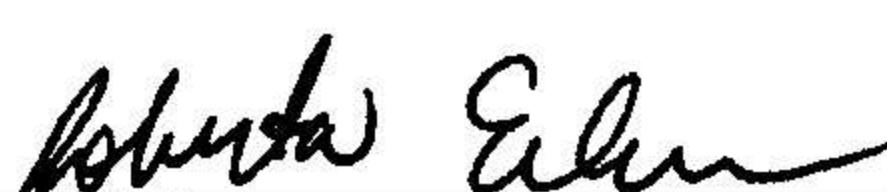
## Certification

The Missouri Department of Health and Senior Services prepared this health consultation for the Valley View Confined Animal Feeding Operation, Report on Exposure Investigation Findings, under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures at the time the health consultation was initiated.



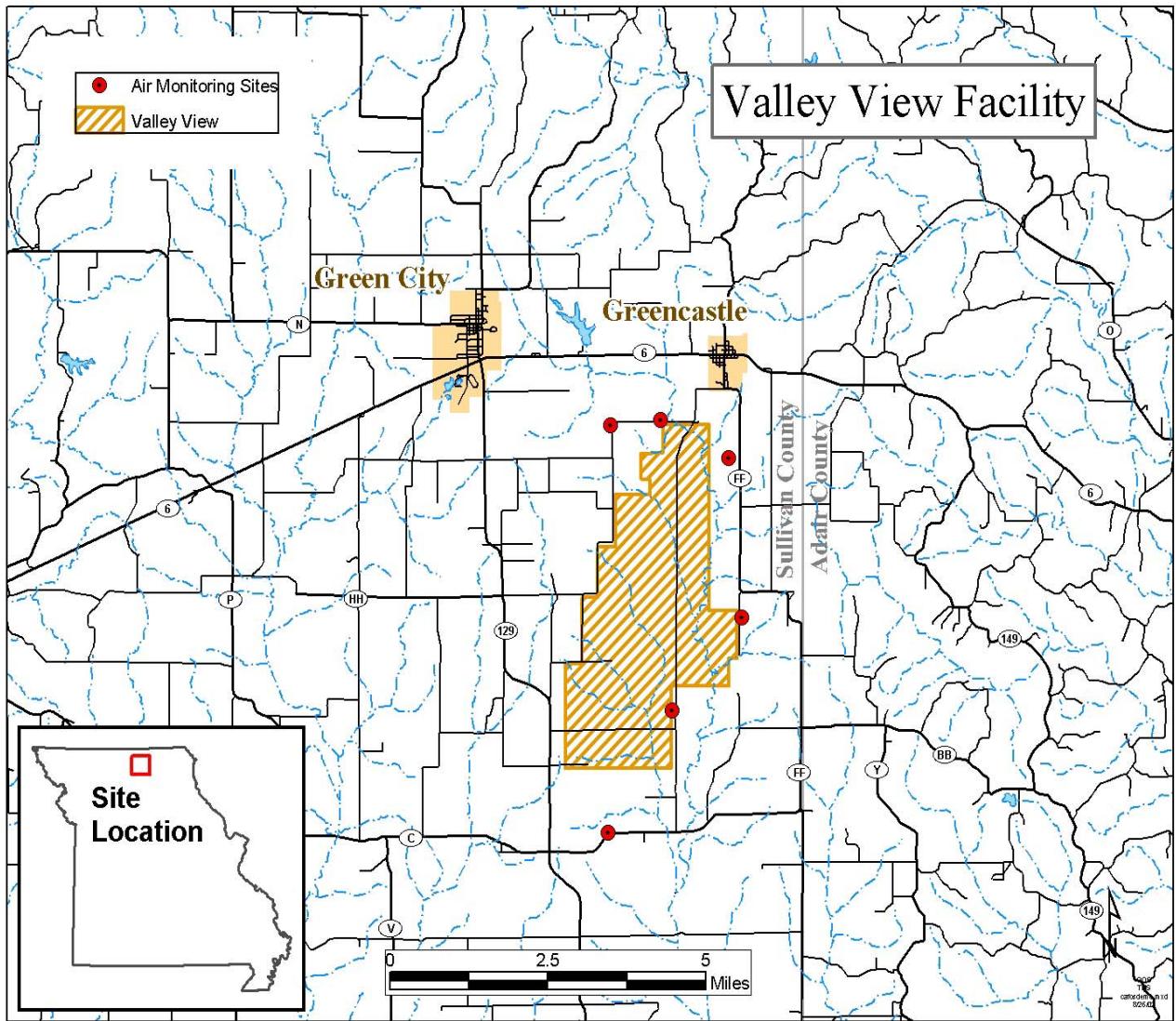
Technical Project Officer, SPS, SSAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

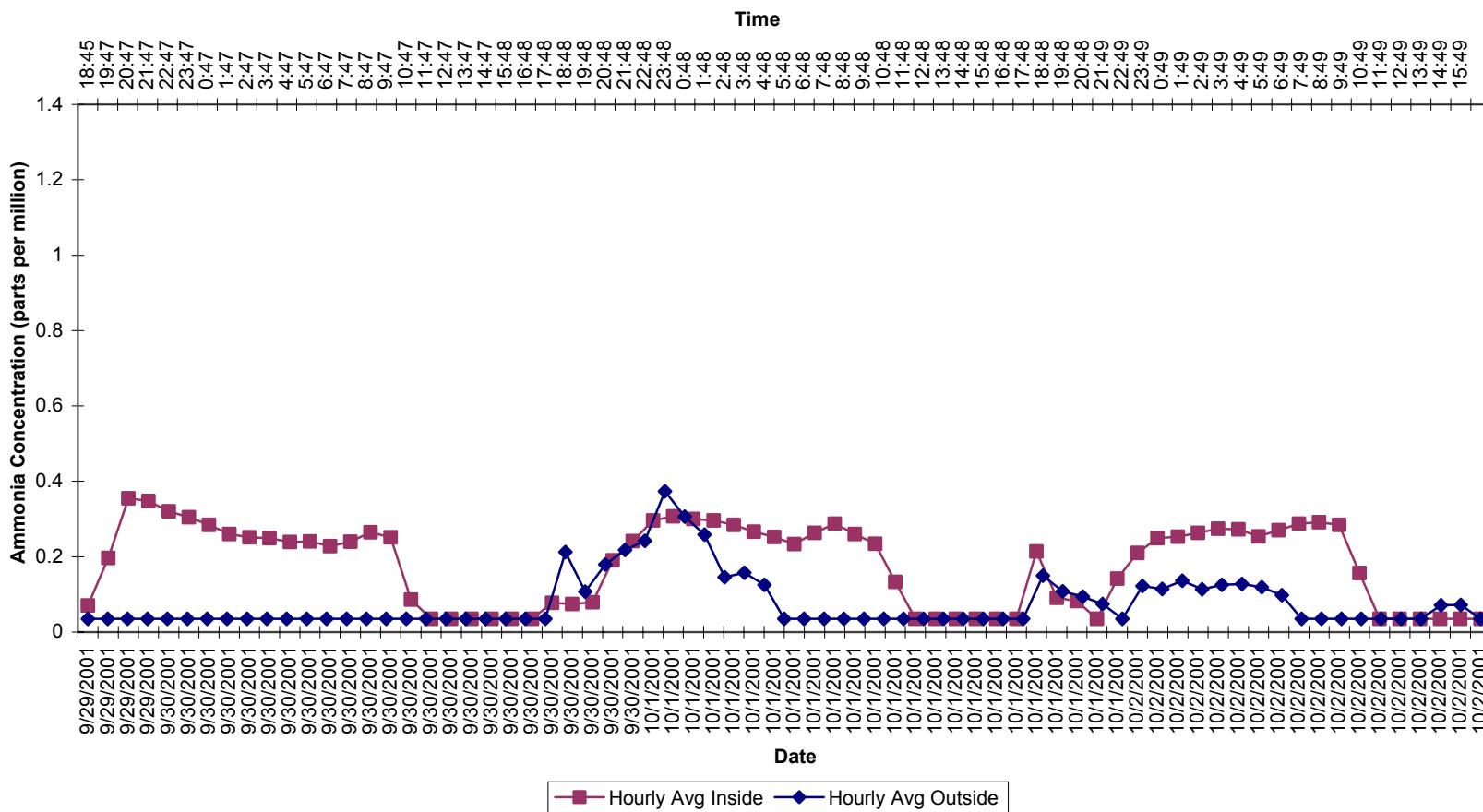


Section Chief, SPS, DHAC, ATSDR

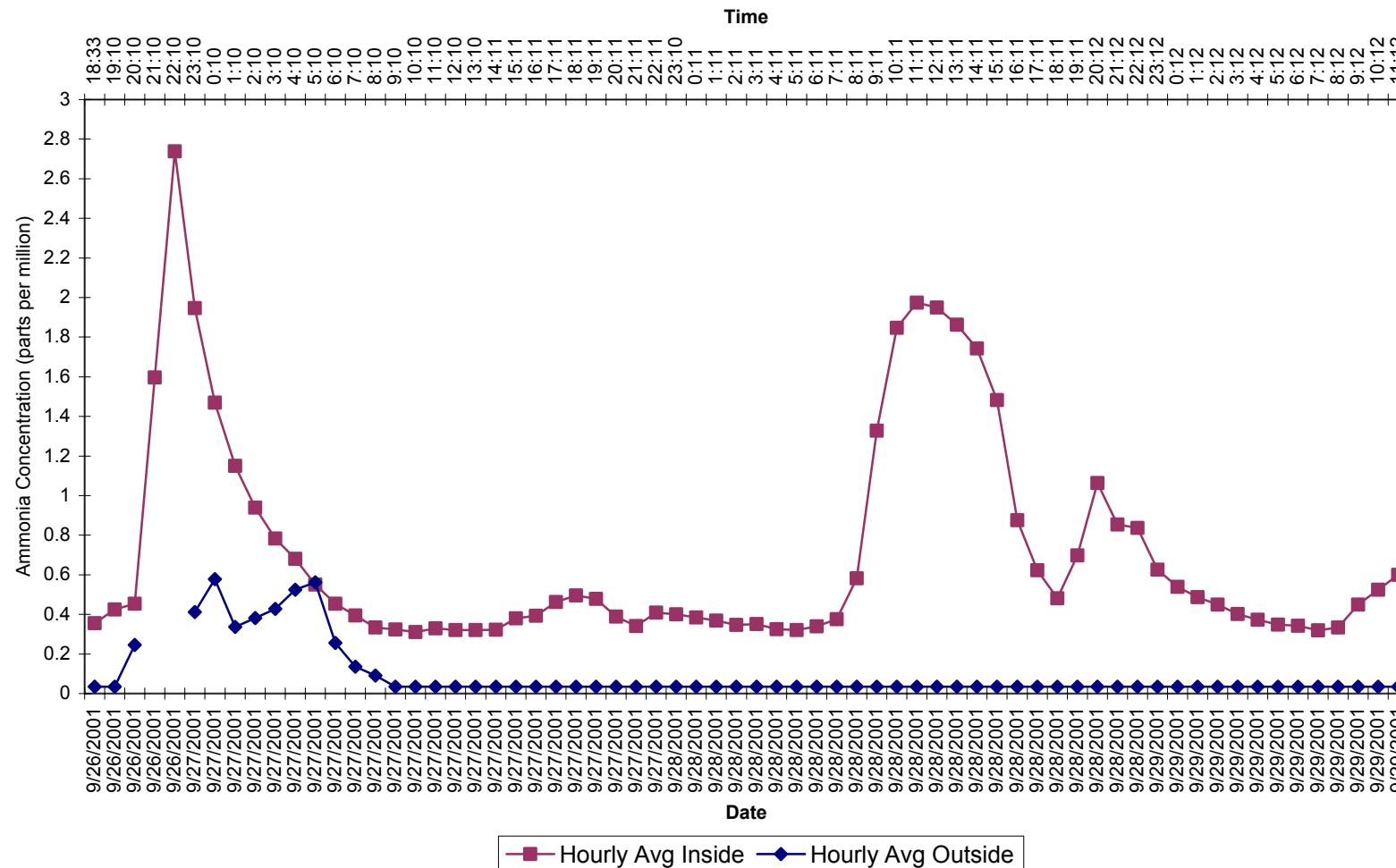
## **Figure 1 – Site Location, Valley View Facility**



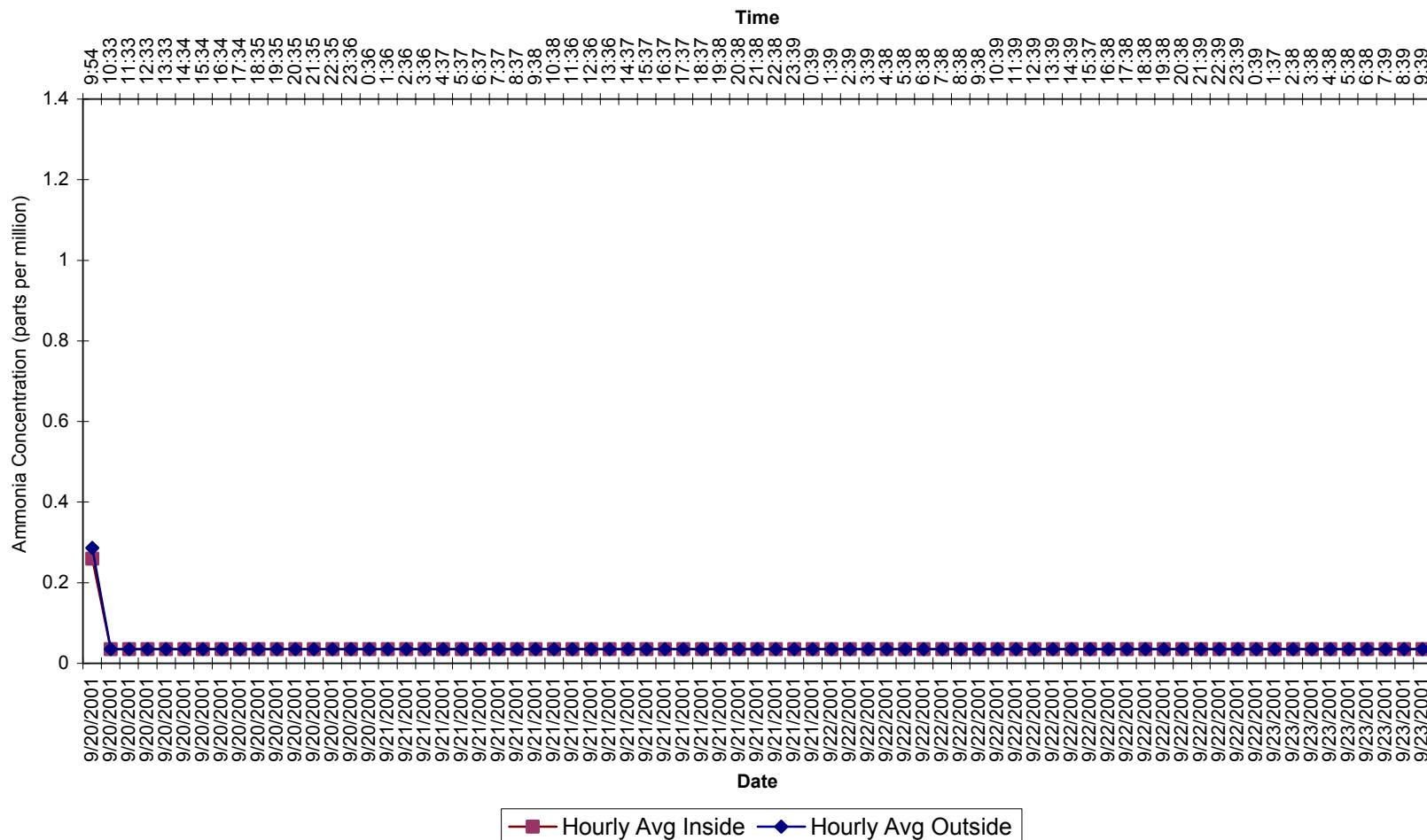
**Figure 2 - Indoor and Outdor Ammonia Hourly Averages, Residence 1028,  
Missouri Department of Health and Senior Services, 2001**



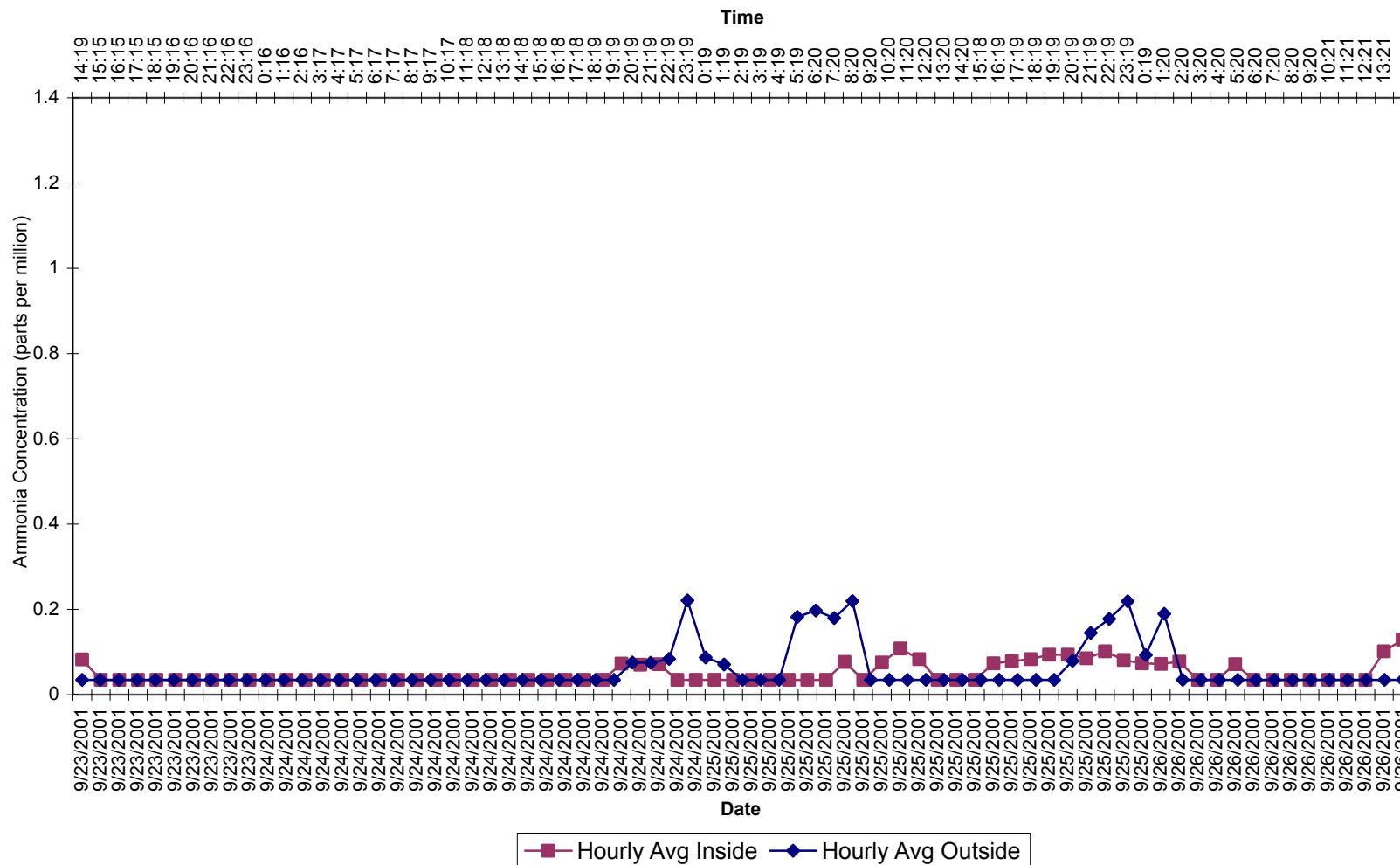
**Figure 3 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1032,  
Missouri Department of Health and Senior Services, 2001**



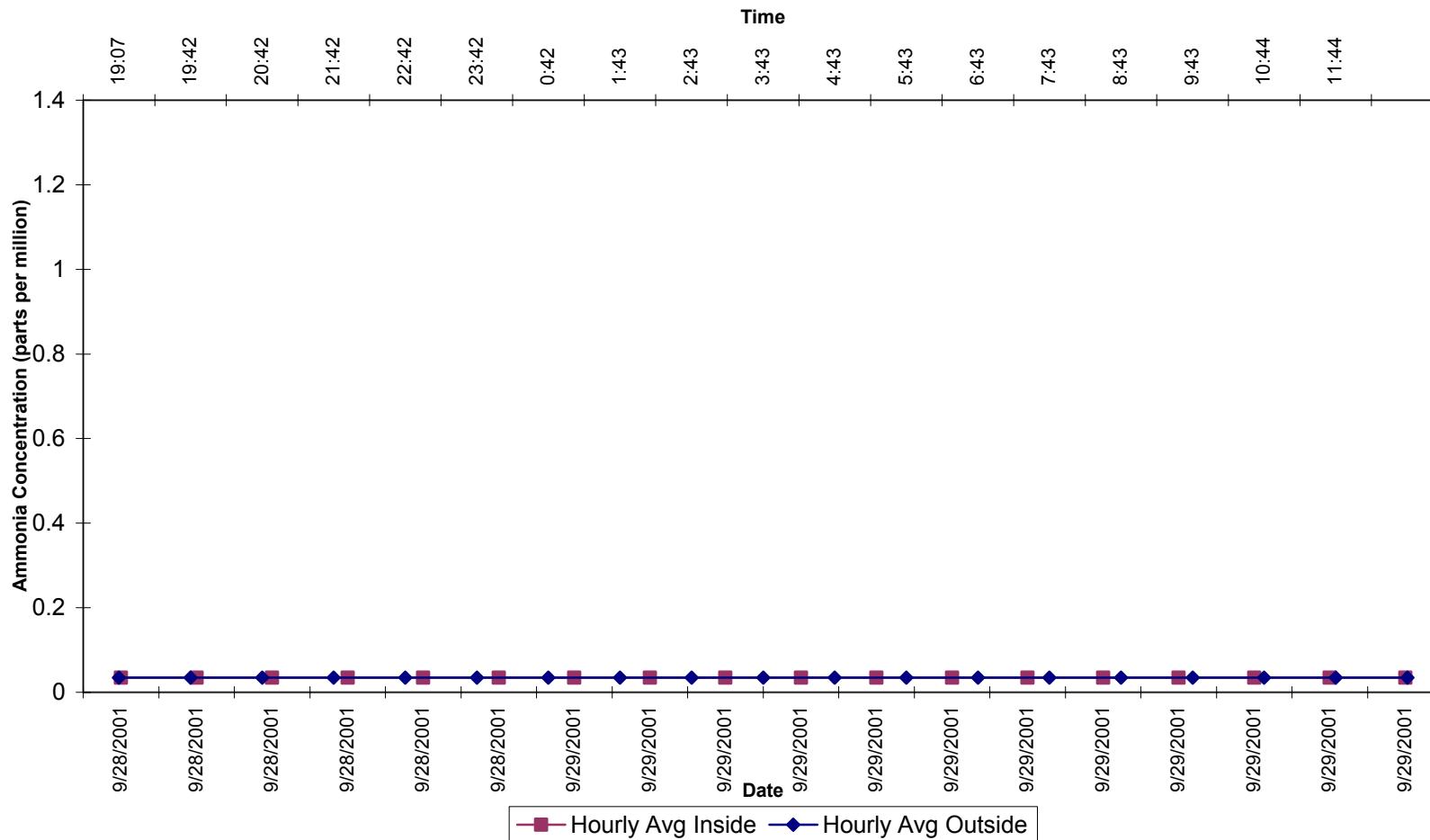
**Figure 4 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1039-1,  
Missouri Department of Health and Senior Services, 2001**



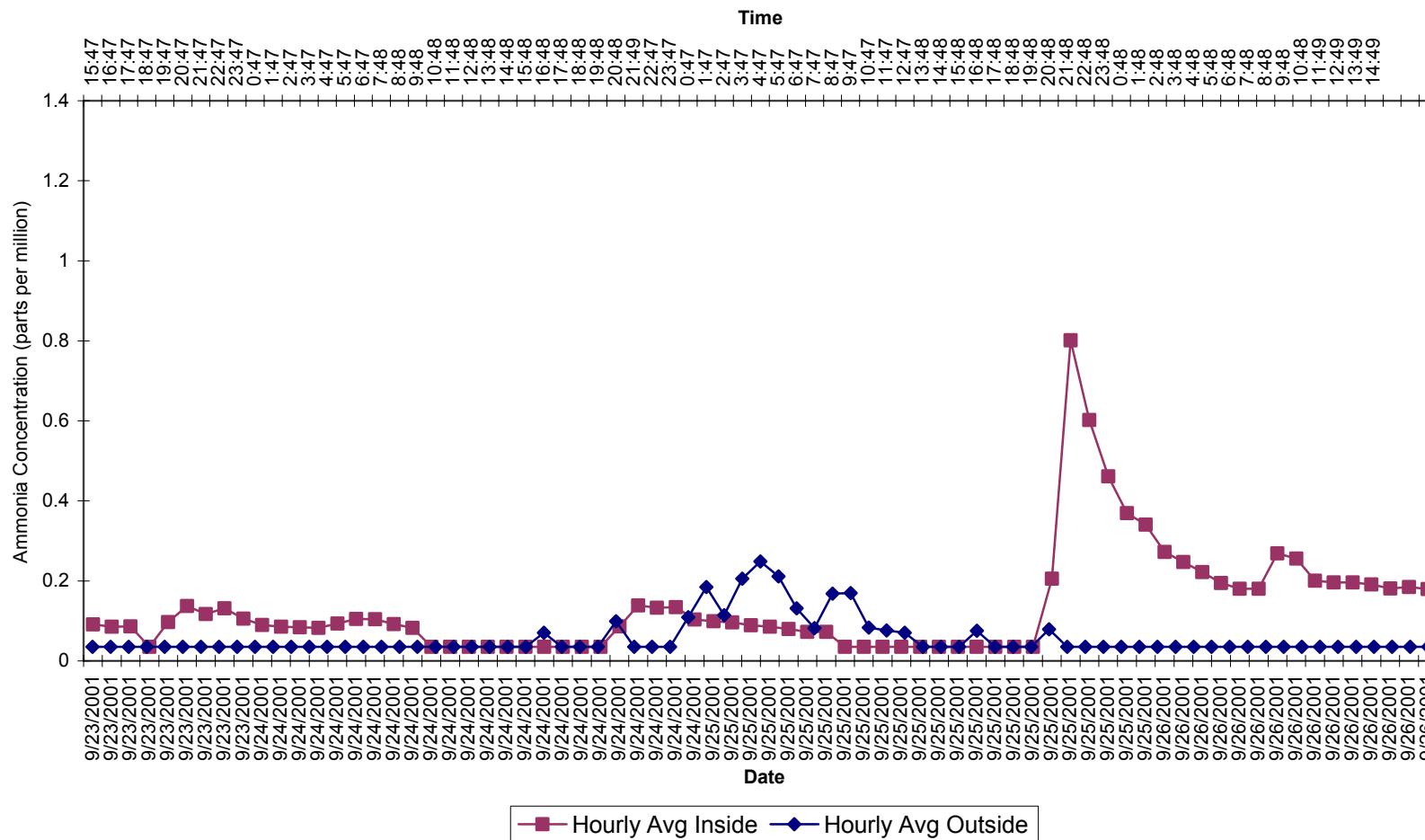
**Figure 5 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1039-2,  
Missouri Department of Health and Senior Services, 2001**



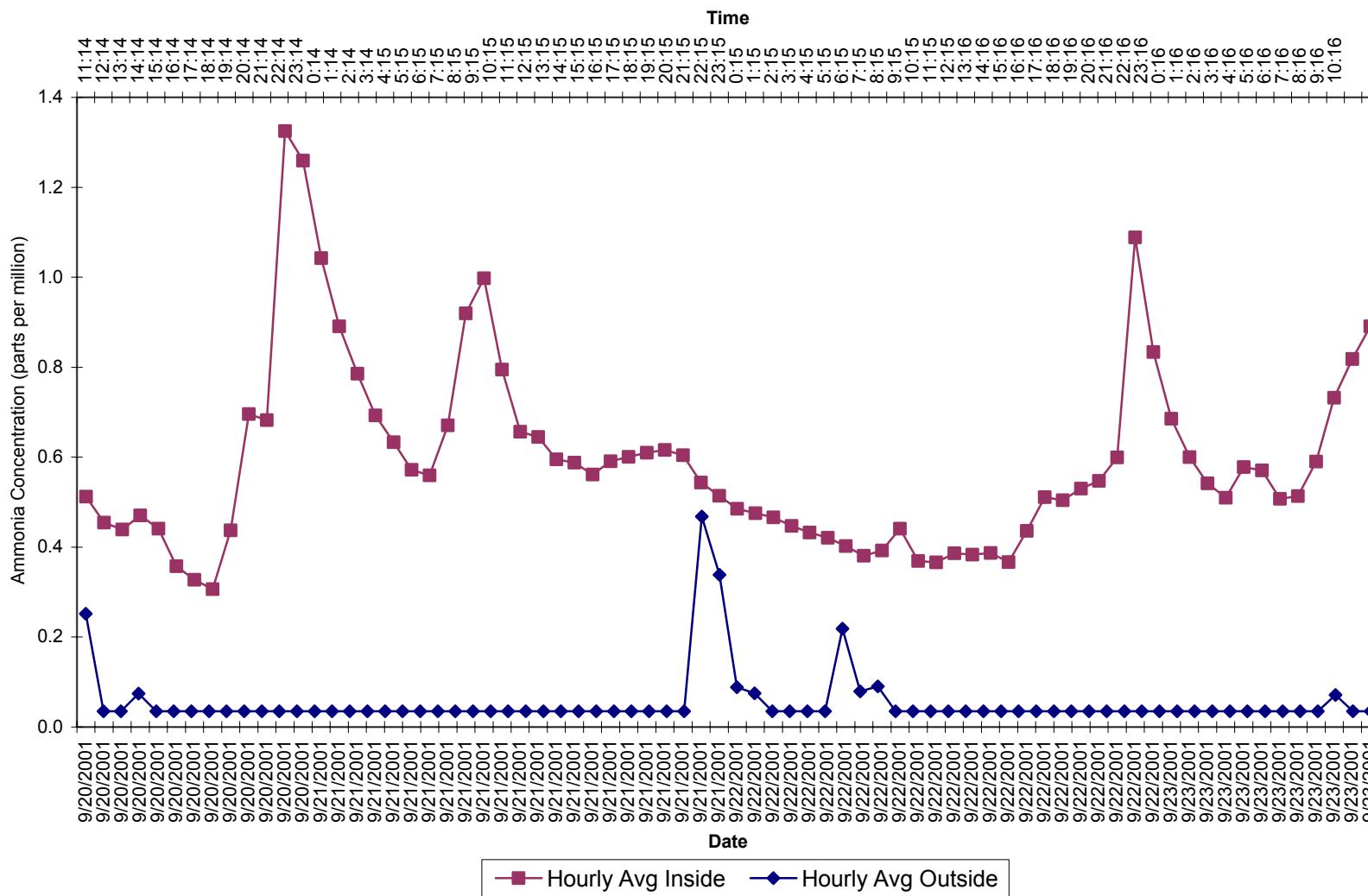
**Figure 6 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1039-3,  
Missouri Department of Health and Senior Services, 2001**



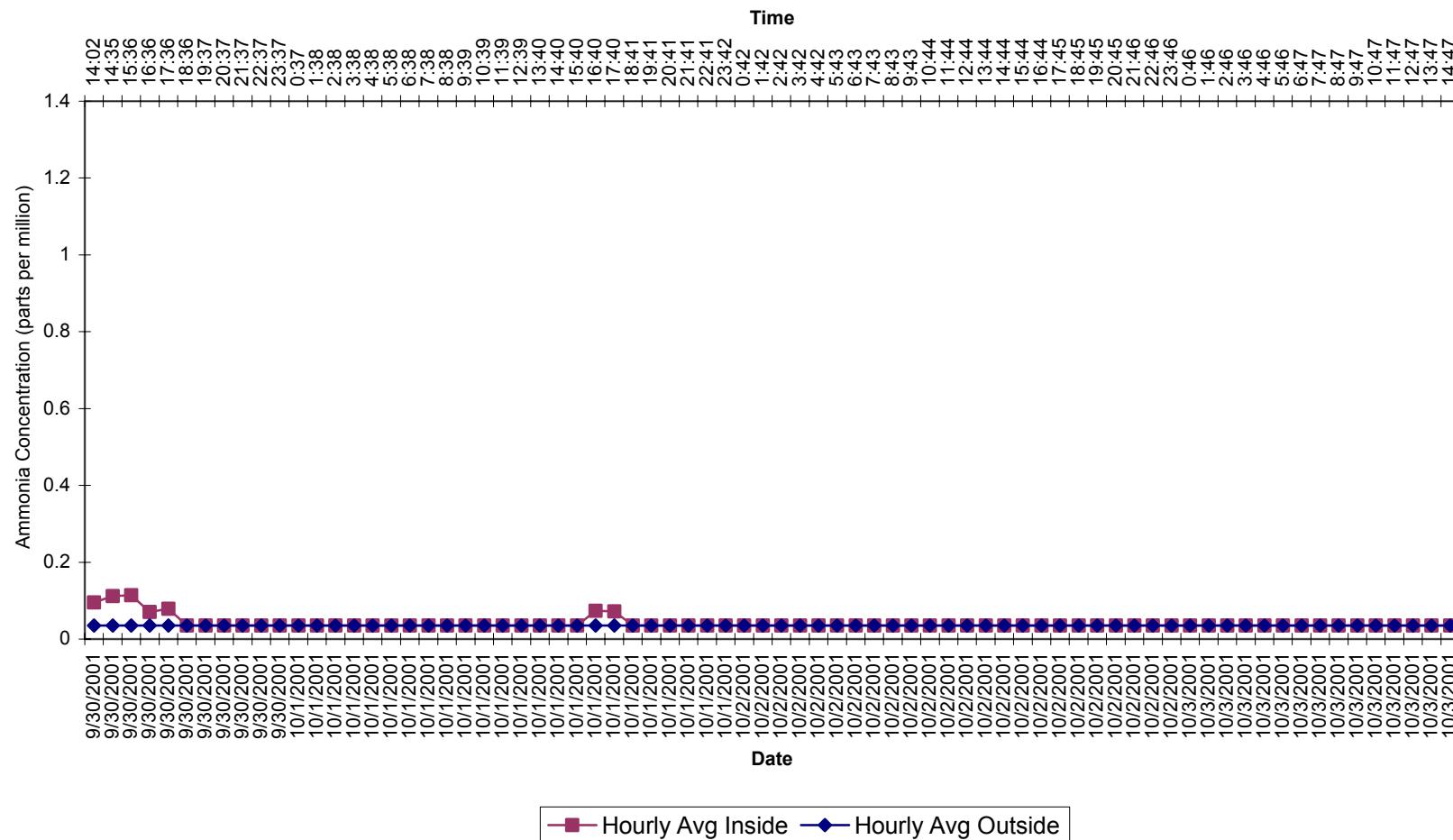
**Figure 7 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1094,  
Missouri Department of Health and Senior Services, 2001**



**Figure 8 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1110,  
Missouri Department of Health and Senior Services, 2001**



**Figure 9 - Indoor and Outdoor Ammonia Hourly Averages, Residence 1111,  
Missouri Department of Health and Senior Services, 2001**



## **Appendix 1**

**Joint Exposure Investigation  
Missouri Department of Health  
and  
the Agency for Toxic Substances and Disease Registry  
Environmental Monitoring Protocol  
Valley View CAFOs Facility  
Green Castle, Sullivan County, Missouri  
CR#A615**

### **Introduction**

Swine Concentrated Animal Feeding Operations (CAFOs) have existed in Missouri since the mid 1990's. These facilities are located in four counties: Gentry, Mercer, Putnam and Sullivan; and are owned by Premium Standard Farms (PSF). This company owns and houses several thousand head of swine at each of its 20 plus facilities. One thousand hogs are housed in each barn, and eight barns are grouped together in a pod. Waste is collected from the pods and stored in lagoons. It is later land applied as fertilizer on fields owned by the company and on fields leased from surrounding landowners.

In the fall of 1999 and 2000, the U.S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR) conducted downwind perimeter air monitoring for ammonia, hydrogen sulfide, and other amines at the White Tail facility. Elevated levels of ammonia were detected. Community members living near this facility have expressed concern that their quality of life has been adversely impacted and that they have experienced an increase in health problems since the CAFOs began operation. The health conditions or problems most frequently mentioned include breathing problems such as increased asthma attacks and attacks with greater severity, recurrent sinus problems, headaches, burning/watering eyes, and a rash on the inside of the mouth and throat that resembles thrush. In addition, area residents claim their quality of life has decreased due to not being able to spend time outdoors or open their windows (due to the odors).

This exposure investigation is intended to evaluate community exposures (residential indoor and outdoor) to ammonia during the period when the CAFOs operation includes emptying and field application of lagoon contents.

### **Purpose**

The purpose of this Exposure Investigation (EI) is to assess the community's level of exposure to airborne ammonia and to determine if the exposures are at levels of health concern. The major objectives of the EI include:

Monitor indoor and outdoor air for ammonia concurrently with MDNR and EPA sampling.

- Collaborate with MDNR and EPA on their collection of indoor and ambient air monitoring data for ammonia and hydrogen sulfide; and,
- Assure community awareness concerning the EI process.

## Methods

### Air monitoring:

The nearest downwind residents will be the focus of the EI. The MDOH/ATSDR investigation will take a minimum of 15 days and will monitor ammonia for three days (approximately 72 hours) at each residence. Simultaneous sampling will occur at one indoor and one outdoor location at each home. Homes to be monitored will be selected based on the homeowner's willingness to participate; the proximity of the home to the CAFOs site perimeter; and whether the home is in the downwind direction of the CAFOs. Monitoring at 10 residences is expected during this EI. To account for any changes in other potential exposure sources, residents will be asked for information that will assist in determining severity and frequency of odors as well as possible indoor ammonia sources (refer to the section that follows). This will be done at the time the air monitoring equipment is placed at the home.

Monitoring will be conducted concurrently with EPA and MDNR ambient air sampling near the facility boundary. MDNR will collect meteorological data from a stationary air monitoring station which has been located at a house in the prevailing wind direction since the late summer of 2001. EPA will be conducting time-weighted air sampling for ammonia in the homes participating in the EI. This time-weighted sampling will occur at the same time that MDOH/ATSDR is monitoring.

MDOH/ATSDR air monitoring will be conducted by the EPA's Environmental Response Team (ERT) Response Engineering and Analytical Contract (REAC), through the ATSDR/ERT Interagency Agreement. Four Innova 1312 Photoacoustic Multi-Gas Monitors will be used to monitor for ammonia. The instrument detection limit for ammonia is approximately 0.07 ppm. Each instrument will be calibrated/certified by California Analytical Instruments, Inc. (CAI), at the site prior to the first residential installation. Certified calibration will use a 10 ppm ammonia standard. After calibration, the instrument will be challenged with ammonia concentrations of 0.5, 1.0, and 5 ppm to verify a linear response in the concentration range of interest. CAI will calibrate the instruments for methane and carbon dioxide using certified 20 ppm and 1000 ppm standards, respectively.

A MDOH representative will be on-site during the 15-day monitoring period. MDOH will acquire access/monitoring consent (attached), keep records concerning the location of the monitoring equipment, and address any concerns expressed by the community participant during monitoring.

All data with personal identifying information will be kept in a locked cabinet. Individual addresses will be assigned a unique number. All forms, surveys, participant folders, etc., will be identified by this number. Data from the survey will be entered into a Microsoft (MS) Access database by SEPH central office staff. Data from the Innova 1312 Photoacoustic monitor will be downloaded onto a notebook computer.

Community information:

Residents of the homes selected for indoor and outdoor monitoring will be asked to describe the type of sewage system they are using; a description of odors noticed, length of time, time of day and frequency of odors, particular days odors are noticed; and the type of heating and cooling systems used. In addition, information on potential indoor sources of ammonia (e.g., cleaning products, hobbies and gardening activities) will be noted. Other concerns and issues that the participants express will be gathered.

## **Data Analysis and Interpretation**

Data analysis will include an evaluation of individual residential results (to be provided to each resident) and an evaluation of all data collected during the 15-day period. Individual evaluations will include the descriptive information collected from participants and MDOH/ATSDR indoor/outdoor air monitoring data. MDOH/ATSDR data will be used to determine residential peak ammonia concentrations and durations. These data will be used to determine if a potential public health hazard exists.

The overall evaluation will utilize concerns and information from the community, all valid analytical ambient air data, and meteorological data. Summarization of the community information will be used to develop descriptive statistics of the population residing closest to the CAFO facility. Ambient and residential air results will be compared to determine dilution effects of distance and relative direction from potential sources (lagoons and/or field application of waste effluent). Topographical features (ridges and watercourses) along with meteorological measurements (wind velocity and direction, relative humidity, and temperature) will be used to interpret any associations found.

Information collected in this exposure investigation will be used for descriptive purposes. If it is determined that exposure to the above contaminants is occurring to off-site residents at a level of concern, there will be recommendations made to environmental regulatory agencies that actions be taken to reduce this exposure.

## **Report**

Upon completion of all data collection and analysis, MDOH will generate a report of activities and results in the form of a Health Consultation. Data will be summarized and aggregated into tabular format. No individual names or descriptors will be in the final report. The Draft Health

Consultation will be submitted to ATSDR for review and approval, then submitted to EPA and MDNR for review. Finally, the report will be released for public comment through a local public availability session. In addition, residence-specific data will be tabulated, evaluated, and provided to the participant. These evaluations will include a health interpretation of the data. These individual reports will be prepared by MDOH and reviewed by ATSDR prior to sending to the participant. Individual reports will be provided to each participant prior to the availability session. Follow-up (e.g., further explanation, clarification of information for each participant) will occur during the same time period as the availability session.

**Attachment—Air Monitoring Consent Form**

I.D. # \_\_\_\_\_

**Participant Consent for  
Swine Confined Animal Feeding Operation (CAFO)  
Exposure Investigation**

The Missouri Department of Health (MDOH), the Agency for Toxic Substances and Disease Registry (ATSDR), the U. S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR) are conducting an investigation of possible exposure to ammonia. My participation in this investigation will help to determine if I am being exposed to this chemical.

The Missouri Department of Health has asked for my participation in this Concentrated Animal Feeding Operation (CAFO) investigation. I understand that this investigation is to look at potential exposure in the areas near a swine CAFO. An interview questionnaire will be completed. The questionnaire concerns personal information and questions about other ways I might be exposed to chemicals. Interviewing for the questionnaire will take approximately 15-20 minutes. When the interview is done, I will be asked to allow air-monitoring equipment to be set up inside and/or outside my home for 3 days. Being in this investigation is a one-time event.

I understand that the information from this investigation will be looked at by the exposure investigation staff along with the other state and federal agencies. I understand that the results of the investigation will be put in a report, but that my name will not be given and that the records will stay private. My name and personal information, other forms used for this investigation, and sampling results will be kept in a locked file cabinet.

The results might lead to future studies that can help protect people living near CAFOs from exposure to elevated levels of ammonia.

**Participation:** There is no provision for compensation or medical treatment in the event of injury as a result of participation in the investigation. I understand that my being in this investigation is voluntary and I may choose to stop participating at any time, even after signing this consent form. If I choose not to participate, or to stop at any time, there will be no penalty.

**Confidentiality:** MDOH, ATSDR, MDNR and EPA will take every reasonable precaution to keep my records confidential. Any information shared with state or local public health agencies will be kept in accordance with applicable state and federal law. Any reports of this investigation will not identify specific individuals and will only give group information.

I.D. # \_\_\_\_\_

Any questions that I may have about this investigation will be answered by Mr. Scott Clardy, whose telephone number is listed below.

Scott Clardy, Missouri Department of Health      573-751-6102 or 1-800-392-7245

I have read or been read the description of this exposure investigation. All of my questions have been satisfactorily answered. I voluntarily request that I be included in this investigation.

Participant Name (Print) \_\_\_\_\_

Participant Signature \_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Phone number \_\_\_\_\_

Witness Signature \_\_\_\_\_ Date \_\_\_\_\_

## Appendix 2

**Summary of Public Comments and Responses**  
**Draft Health Consultation**  
**Report on Exposure Investigation Findings**  
**Valley View Confined Animal Feeding Operations**  
**(a.k.a. Concentrated Animal Feeding Operations)**  
**Green Castle, Sullivan County, Missouri September 30, 2002**

1. **Comment:** I urge you to study the effects of these operations further. There are things in the air here that do make us sick. And our lifestyles are affected by the stench on a daily basis. I kindly ask that your agency further study the effects that this operation has on the health of the people that live around them.

**Response:** In response to your request that the Missouri Department of Health and Senior Services (DHSS) continue to study the effects of confined animal feeding operations on the health of nearby communities, the final report on this Exposure Investigation strongly recommends that additional long-term air monitoring be conducted around this facility.

This comment was received from 13 people.

2. **Comment:** The numbers of animals housed at the Valley View Facility is incorrect.

**Response:** The number has been corrected in the final Health Consultation. DHSS requested documentation to verify the number.

This comment was received from 2 people.

3. **Comment:** Different scales were used on the various graphs and in data representation, making the data hard to compare.

**Response:** The final Health Consultation has been changed to parts per millions (ppm).

This comment was received from 2 people.

4. **Comment:** Monitors were only in downwind direction 10% of the time and no monitoring sites were located on the West, WNW, and WSW side.

**Response:** Monitor location was based on wind predication for the time of the monitoring.

This comment was received from 2 people.

5. **Comment:** How can the conclusion indeterminate public health hazard and ammonia exposures classified as no apparent public health hazard be made when the monitors were

only downwind 10 % of the time and there was little land application of effluent?

**Response:** We do not consider this Exposure Investigation conclusive for year-round exposures. The conclusion of the Exposure Investigation is only for the specific time period that the sampling occurred. During that period, ammonia levels did not reach a level of health concern. That is why we recommend further long-term air monitoring. We emphasize the need for further sampling in the final copy.

This comment was received from 3 people.

6. **Comment:** The report states ammonia is a respiratory irritant but no specific information about medical conditions, health affects or dates and location of sampling is given in the health consultation.

**Response:** No medical information was collected in the Exposure Investigation. However, if it had been collected, confidentiality concerns would prevent reporting some of the information. Dates and locations of sampling cannot be placed on the map or released because of confidentiality issues.

This comment was received from 2 people.

7. **Comment:** Averages for residences 1032 and 1110 were above the MRL's. What is causing that?

**Response:** We have re-checked the data and graphs in the final Health Consultation. Additionally, we plan to visit with the residents to discuss possible alternative sources of ammonia that might be present in these homes.

This comment was received from 3 people.

8. **Comment:** Were EPA monitoring results from other CAFO sites used for comparison?

**Response:** No, the other data was not used. Only data obtained around the Valley View Site was used because the Exposure Investigation was specific to this site.

This comment was received from 1 person.

9. **Comment:** Concerns about the reliability of the Innova 1312 Photoacoustic Multi-Gas Monitors for low-level concentrations and the graphs showing lower values than the minimum detection limit for the monitor.

**Response:** This was the best portable instrument DHSS could find that would work for monitoring inside and outside individual homes. DHSS believes the instrument was reliable for monitoring ammonia levels that are of health concern. All values reported by the

instrument that were less than 0.070 ppm were listed at 0.035 ppm (half the difference between 0 and the detection limit of 0.070) in the data analysis. This is an acceptable method of data analysis.

This comment was received from 1 person.

**10. Comment:** Data from the MDNR site in Green Castle was reviewed only through December 2001.

**Response:** DHSS was unable to obtain this data prior to the release of the draft Health Consultation. We have obtained and reviewed additional data from the Green Castle site and included it in the final Health Consultation.

This comment was received from 1 person.

**11. Comment:** Monitoring by EPA and MDNR is mentioned but no data is included in the report. It is unknown whether data from the Innova matches data from the other agencies' instruments. Why didn't EPA review the results of the Exposure Investigation before they were released?

**Response:** We worked with MDNR staff on data matching and comparison. Additionally, we collaborated with MDNR and EPA in monitoring, however, DHSS is the author of this Health Consultation. EPA has had the opportunity to review the draft document and has provided comments.

This comment was received from 2 people.

**12. Comment:** Additional measurements should be considered for ammonia, particulate matter (with speciation), hydrogen sulfide and wind conditions for July through September. A 12-month study would be unnecessary because standards apply to shorter-term exposure (1 to 14 days, or less).

**Response:** MDNR is continuing the ammonia air monitoring at Green Castle. They have moved the monitoring station to a house that participated in the EI. We are interested in long-term data on ammonia levels, not just July through September. MDNR collects wind conditions at their Monitoring site.

This comment was received from 1 person.

**13. Comment:** Explain the significance of indoor ammonia concentrations within the meaning of public health hazard and, if relevant, explain why the measurement of ambient outdoor concentrations alone are not sufficient for evaluation of risk. Consideration should be given to exposures to those who work outdoors.

**Response:** This Exposure Investigation was conducted to examine both indoor and outdoor ammonia exposures. Our conclusions reflect analyses of both indoor and outdoor data. It was not designed to examine occupational exposures or comment on the relative risk of either environment.

This comment was received from 1 person.

14. **Comment:** Further consideration should be given to the findings and recommendations of the Iowa Study as part of its evaluation of the potential health risk associated with this facility.

**Response:** We will review the Iowa Study; however, DHSS has based its conclusions and recommendations on current science.

This comment was received from 1 person.

15. **Comment:** Speculation is offered about why indoor ammonia values were higher than outdoor values, but there could be additional explanations that are not presented.

**Response:** DHSS added additional explanations/information about causes of indoor ammonia in the final version.

This comment was received from 2 people.